

Warsaw School of Economics  
Collegium of Economic Analysis

# The impact of major central banks' unconventional monetary policies on the term structure of Polish interest rates

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Piotr Bartkiewicz

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Professor Michał Rubaszek

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## Introduction

The dynamics of banking, financial and economic systems in most countries worldwide are dependent on exogenous developments abroad. Hardly any country is truly closed or insular, and policymaking often takes into consideration the external environment, including decisions and expected decisions of foreign policymakers. For emerging markets (EM), the problem is even more acute due to their dependence on external debt or financing current account deficits with large-scale capital inflows, often short-term portfolio flows. While these issues are most commonly associated with recent experiences of EM economies, this is nothing more than availability heuristic. These mechanisms had already existed in the so called first era of globalization (before 1914) - and stories of large-scale capital inflows and outflows between financial centers and hitherto emerging markets will be familiar to economists and economic historians alike (Davis & Gallman, 2001; Reinhart, Reinhart, & Trebesch, 2016).

The issue returned in the post-Breton Woods era, when systematic liberalization of capital flows, financial deregulation and rapid rise in the volume of international trade have led to what is usually called globalization, but in fact was its second wave (Bordo, Taylor, & Williamson, 2004). Expanded role of EMs is dated to that period (1970s and 1980s). The literature tackling the second wave of globalization was triggered by EM financial crises of the 1980s and went through several phases. It describes EM crises (Calvo, Fernández-Arias, Reinhart, & Talvi, 2001; Calvo & Reinhart, 2002), contagion (Allen & Gale, 2000; Forbes & Rigobon, 2002; Pericoli & Sbracia, 2003) and determinants of capital flows in and out of EMs (Calvo, Leiderman, & Reinhart, 1993, 1996). After the global financial crisis of 2007-2009, the focus has shifted towards the impact of unconventional monetary policies (with emphasis on asset purchase programmes, known as quantitative easing, QE) conducted by central banks in developed markets (DM) on EM economies, including financial variables. While most recent literature is focused on the determinants of capital flows into EMs and the role of monetary policy in inducing them, it builds upon several earlier strands of the literature and touches issues such as the architecture of the global financial system and monetary sovereignty of small open economies.

Multiple studies have shown that unconventional monetary policies pursued by major central banks are associated with larger capital inflows, stronger EM currencies, higher equity prices and lower interest rates (Bhattarai, Chatterjee, & Park, 2015; J. Chen, Mancini-Griffoli, & Sahay, 2014; Fratzscher, Lo Duca, & Straub, 2018; Gilchrist, Zakrajsek, & Yue, 2016). This also pertains to Poland and other countries in the region (Babecká Kucharčuková, Claeys, & Vašíček, 2016; Bluwstein & Canova, 2016; Bowman, Londono, & Sapriza, 2015; Rai & Suchanek, 2014). However, the CEE region is relatively understudied in this context as the vast majority of empirical studies on the impact

of major central banks' monetary policy spillovers has focused on Latin American and East Asian EMs. At the same time, it is insufficient to describe interest rate reaction to foreign monetary policy developments in yield terms alone. This must be traced back to theoretical and empirical features of market-based interest rates.

The notion of interest rate is one of the oldest in economics and most fundamental for our understanding of economic processes. However, in practice there is more than just one interest rate, namely a vast set of interest rates on different instruments from different issuers, with varying risk characteristics and maturity, among others. Interest rates of comparable characteristics, related to a single issuer, can be ordered by maturity to form a yield curve. The yield curve represents the time value of money (or to be exact, the time value of liabilities). Among all possible yield curves, special place is reserved for the government liability curve, which is considered to have the lowest risk premium component. The relationship between the interest rate of a given maturity and the maturity is known as the term structure of interest rates (Cairns, 1977; Fabozzi, 2012). Research into the term structure has been conducted over the past 40+ years, starting with the seminal paper of Vasicek (1977), and pursues the following basic goals:

- (1) reduction of the dimensionality of the curve;
- (2) accurate representation of the cross-sectional features of the curve (e.g. its shape);
- (3) accurate representation of dynamic features of interest rates.

Additionally, most term structure models are initiated with a set of assumptions regarding the behavior of economic agents, yielding a partial equilibrium, and including no-arbitrage conditions. At the turn of 1990s and 2000s dynamic affine Gaussian term structure models have become the gold standard in the literature (Christensen, Diebold, & Rudebusch, 2009; Duffee, 2002; Duffie & Kan, 1996). Their key feature is the reduction of a panel of interest rates into a limited number of dynamic factors linked by theoretical restrictions.

For long it has been known that medium- and long-term interest rates are driven by several factors and are less predictable than the simplest theoretical model based on expectations regarding future path of short-term interest rates would suggest (Rudebusch & Sack, 2006; Wright, 2011). This result is consistent with the existence of the term premium, which represents the difference between a bond's yield and the average of expected short-term interest rates calculated over the corresponding maturity (Cohen, Hördahl, & Xia, 2018; Gürkaynak & Wright, 2012; Kim & Wright, 2005; Wright, 2011). The existence of such a premium has been found both in within-country settings, and in international comparisons. In most general terms, bond yields globally are highly correlated and have a unique common driver. At the same time, monetary policy can impact bond yields through different channels and manifest itself in different components of the yield curve (Christensen & Rudebusch, 2012). On one hand, the impact takes place through signaling as expected paths of short-term interest rates co-

move, in part due to common fundamentals. On the other, it might be related to behavioral changes effected in investors and economic agents by the central bank. In the former view, EM yields are reduced by unconventional monetary policies of major central banks, because markets are expecting the EM central bank to follow its foreign counterpart. In the latter, EM yields fall because investors change their preferences and risk perceptions or are forced to increase risk exposures by central bank actions.

## **Research hypothesis and goals**

The main hypothesis of this dissertation is:

**Unconventional monetary policies of major central banks, including asset purchase programmes, affect Polish interest rates significantly and mainly through term premia channels.**

The additional hypotheses are:

- a. Polish local currency bond market has evolved considerably since the beginning of Poland's economic transition. However, the key characteristics have not changed since 2005, allowing for an unhindered use of data from this period for research purposes.
- b. Liquidity in the Polish local currency bond market is affected by local and global factors. However, it has slightly improved over the past ten years.
- c. Unconventional monetary policy tools affect EMs both directly and indirectly. The former is through capital flows and behavioral changes effected by monetary policy decisions, the latter through growth spillovers.
- d. Monetary easing using unconventional tools is associated with lower bonds yields in EMs. This also applies to Poland.
- e. Before 2022, the global decline in term premia contributed to the overall decline in Polish government bond yields and, over the medium term, this component of the Polish yield curve is highly correlated with its counterparts from abroad.

## Key results

The dissertation consists of six chapters, where each is based on my papers, four of which are published in academic journals:

- (1) Bartkiewicz, P. (2021). The evolution of the Polish government bond market. *Public Sector Economics*, 45(1), 149-169.
- (2) Bartkiewicz, P. (2021). Ebbs and flows: the determinants of local currency bond market liquidity in Poland. *Macroeconomics and Finance in Emerging Market Economies*, 14(2), 200-218
- (3) Bartkiewicz, P. Optimal empirical strategy for deriving the spot curve in Poland. Unpublished manuscript.
- (4) Bartkiewicz, P. (2018). Quantitative easing: new normal or emergency measure? *Contemporary Economics*, 14(3), 306-320
- (5) Bartkiewicz, P. (2020). The Impact of Quantitative Easing on Emerging Markets: Literature Review. *Financial Internet Quarterly „e-Finanse”*, 14(4), 67–76.
- (6) Bartkiewicz, P. (2022) The impact of major central banks' unconventional policies on the term structure of Polish interest rates. Under review in *International Review of Economics and Finance*.

Chapter 1, entitled "The evolution of the Polish government bond market", describes long-term trends in the Polish local currency debt market by highlighting changes in several key features: issue size and its distribution, maturity structure, ownership structure and composition in terms of instruments. As noted by Prasad, Rajan, & Subramanian (2007) and Wirgler (2000) the country's ability to borrow in its own currency is an important stage of economic development and a well-functioning debt market plays an important role for public and private actors. The local currency debt market is one of many that were created essentially from scratch during Poland's economic transformation in the early 1990s. The subsequent financial deepening of the Polish economy, coupled with significant disinflation and the establishment of financial market institutions, allowed the debt market to grow and increase in complexity. Using the aforementioned metrics, I present evidence that the Polish local currency debt market stabilized and - to use a colloquial term - matured between 2005 and 2009. By then, market fragmentation was severely reduced and the market became dominated by several high-size liquid issues of various maturities. Maturity structure has also stabilized and the role of Treasury bills and other short-term instruments diminished. I also highlight several important events that helped shape the market: the establishment of mandatory private pension funds, large-scale bond issuance during and after the global financial crisis due to worsening of fiscal situation (Aizenman & Pasricha, 2013; IMF, 2010), the ebbs and flows of foreign capital following the global financial crisis, the subsequent changes in the pension systems, culminating in the redemption of all bonds held by private pension

funds (IMF, 2011; Jakubowski, 2016, 2017), the tax on bank assets (UKNF, 2016; Wojciuk, 2017). Despite those factors, the market continued to function unimpeded. I argue that price discovery occurs on the market and that most significant structural changes occurred prior to 2005.

Chapter 2 investigates the determinants of local currency bond market liquidity in Poland. Quick and efficient processing of new information is a desired feature of financial markets as it facilitates price discovery and allows the markets to serve their role to all participants and observers. The bond market is not different. Government bonds are frequently traded assets and the existence of a liquid market is important for public debt management and efficient conduct of fiscal policy. A liquid market is also providing higher quality information. In Chapter 2 I describe how the liquidity of local currency government debt market in Poland changed over time and what were the main determinants of this change. Bid-ask spread measured in percentages is considered as a preferred measure of liquidity and a proprietary dataset of individual bond prices webscrapped from daily fixing tables published by Warsaw Stock Exchange's BondSpot trading platform is used. I investigate the impact of local and global factors as well as bond issue characteristics on the bid-ask spreads using panel regressions. I show that the Polish local currency government bond market behaves in line with expectations and patterns observed in other countries. I conclude by showing how the bid-ask spreads are dependent on global factors, such as risk spreads, but not on central bank announcements. It can be noted that the Polish government debt market is a reliable source of information, where price discovery occurs unimpeded and that these characteristics persisted despite significant changes in the institutional environment.

In Chapter 3 I discuss the optimal empirical strategy for deriving the spot curve in Poland. For that purpose I assess the applicability of several common yield curve intrapolation methods for daily bond price data in Poland and consider the trade-offs inherent in choosing an empirical strategy. I consider three methods of intrapolation: Nelson-Siegel (1987), Diebold-Li (2004) and cubic splines (McCulloch, 1971). The methods are evaluated, both in-sample and out-of-sample settings with root mean square errors (RMSEs) calculated on the basis of price errors, duration-adjusted price errors and yield-to-maturity errors. The daily bond price dataset constructed in Chapter 2 is utilized. I present evidence of tradeoffs between transparency, mathematical simplicity and empirical fit. For sensitivity analysis, I consider the merits of including short-term offered interbank interest rates as proxies for the shortest end of the curve. In my assessment, the theoretical justification of combining information from instruments characterized by different liquidity, credit and counterparty risk as well as lack of transactional value from Polish interbank rates at maturities relevant for yield curve estimation leads to the conclusion that this kind of modeling choice is problematic.

Chapter 4 is focused on a question if the quantitative easing (QE) is a new normal or emergency measure? It briefly describes the most common type of unconventional monetary policy that has arisen

during the Global Financial Crisis of 2007-2009 (GFC), e.g. large-scale asset purchases (LSAPs). Those policies were enacted as ways of stabilizing markets and providing monetary stimulus to major economies, in which the conventional monetary policy has largely run its course due to the presence of zero lower bound on nominal short-term interest rates (Żywiecka, 2013). A debate has arisen in the literature and in popular press, where the authors were discussing if those policies are inevitable due to long-term structural trends or rather they are an emergency tool, justified only by the severity of the recession? In the former case, the argument was that there is a long-term, secular decline in nominal and real interest rates in all major economies and across maturities (Bauer & Rudebusch, 2016; Desroches & Francis, 2006). It is posited that this reflects a decline in equilibrium real interest rate, resulting from factors such as demography, globalization and persistent imbalances in global balance of payments flows (G. B. Eggertsson, Mehrotra, & Robbins, 2019; G. Eggertsson & Mehrotra, 2014; Eichengreen, 2014; Gordon, 2012). This long-term decline implies that each monetary policy easing cycle has become shallower and each tightening cycle has resulted in a lower peak policy rate. Eventually, the lower bound on policy rates would have been hit with or without the trigger that had in reality caused it. In the latter case the arguments are that monetary policy response to the crisis must be judged by the circumstances and that unusual conditions that spurred unconventional tools will not be repeated once the economy returns to normality (IMF, 2009; Lo & Rogoff, 2015). It should be noted that at the time of writing the chapter the events of 2020 (the COVID-19 pandemic, global recession, the associated policy response and subsequent war in Ukraine - see e.g. IMF, 2020) were not known. However, the 2020 policy response to the recession has seen widening in the scope, size and popularity of QE, strongly supporting the case that asset purchases have become a standard tool of monetary policy and that the return to zero lower bound was not an anomaly .

Chapter 5 presents a literature review on the impact of quantitative easing on emerging markets. I start by indicating that monetary transmission is generally considered in domestic context, since both theoretical and empirical studies focus on the effectiveness, impact size and transmission channels of monetary policy actions to the domestic economy. No central bank, however, operates in vacuum, and domestic conditions informing monetary policy decisions as well as their effects depend on the external environment. Unconventional monetary policies pursued by major central banks are part of this environment. Their impact on emerging market economies has several dimensions: via trade links and higher demand for foreign products; through signaling; risk taking, risk premium and portfolio balance channels (Bernanke, 2012; J. Chen et al., 2014; Ehrmann & Fratzscher, 2009; Krishnamurthy & Vissing-Jorgensen, 2011, 2013). In other words, unconventional monetary policies influence the behavior of investors and provide informational context about common fundamentals. In this article I conduct an analysis of available empirical studies on the impact of quantitative easing on emerging market economies and financial markets. I find that quantitative easing conducted by major central banks in developed economies resulted in higher economic growth in emerging markets, larger capital

inflows, currency appreciations and lower government bond yields. I also discuss that the empirical literature is focusing predominantly on spillovers from the Federal Reserve's unconventional policies on emerging markets most closely associated with the dollar, namely Latin American and Eastern Asian economies. Central and Eastern European economies (CEE) appear understudied in this respect. In addition, I find a common identification problem - the widely reported result regarding lower bond yields might be caused by any combination of known transmission channels. This lack of identification calls for conducting an in-depth analysis of the EM debt market's reaction to unconventional policies of major central banks.

In Chapter 6 I provide an answer to the main research question of this thesis, namely: What is the impact of major central banks' unconventional policies on the term structure of Polish interest rates. In particular, I show how announcements of unconventional monetary policies from major central banks impact the term structure of Polish interest rates and Polish bond market in general. For that purpose, I estimate a dynamic term structure model using Polish data and utilize it to decompose yields into expected future path of short-term interest rates and the term premium. Due to its attractive characteristics and availability of estimates for other countries, I use the ACM model (Adrian, Crump, & Moench, 2013). I find that the two components of the yield curve behave differently. The expected future path of short-term interest rates is closely correlated with actual changes in the NBP policy rate, and hardly affected by external factors. On the contrary, the term premia are highly correlated across borders. This is in line with the empirical literature, which highlights the contribution of term premia to the variability of bond yields, cross-country correlations between term premia and, in general, the existence of an international driver of bond yields and bond returns, independent from local fundamental factors. In addition, I show that the term premia in Polish yields have declined visibly in recent years, matching the experience of other countries. The direct impact of unconventional measures of major central banks is, however, to a large extent driven by expectations, which suggests that there is a strong signaling component in external transmission of unconventional monetary policies. I also compare the reaction of the bond curve with the reaction of the swap curve and find less contribution from term premia in the swap curve reaction.

The results presented in the dissertation paint a clear picture of Polish local currency bond market as an integral part of the broader universe of the global market. It pertains to its evolution, structural characteristics, liquidity picture and reactions to monetary policies of major central banks. It also shows how popular methodologies of yield curve intrapolation and dynamic term structure modeling can be successfully applied to the Polish data.

The thesis contributes to the literature in several ways.

- (1) It includes the construction of a proprietary bond price database by webscraping daily fixing tables published by the Warsaw Stock Exchange on its BondSpot trading platform.



- (2) It investigates informational context of Polish bond data via econometric assessment of changes in market liquidity on the secondary market and their drivers.
- (3) It provides an up-to-date assessment of appropriateness of common yield curve intrapolation methods for Poland, using individual bond price data of daily frequency.
- (4) It presents estimates of the dynamic term structure model for Poland using the broadest possible sample.
- (5) It offers a rigorous assessment of the relative role of various channels in the transmission of foreign central banks' monetary policy onto the Polish bond market. Contrary to a significant portion of extant literature, it finds a significant role of the signaling channel.

## **Concluding remarks**

The main hypothesis of this dissertation was:

Unconventional monetary policies of major central banks, including asset purchase programmes, affect Polish interest rates significantly and mainly through term premia channels.

This hypothesis was directly addressed in Chapter six. I judge that this hypothesis was partially confirmed. While the impact of unconventional policies of major central banks was indeed significant, it occurred both through term premia and expected future interest rates. Over the entire period studied, term premia embedded in Polish bond yields and swap rates have been highly correlated with term premia found in other markets (I have used data from the United States and the euro area) - this also confirms one of the additional research hypotheses (e). The short-term reaction of Polish curve to announcements regarding unconventional monetary policies of major central banks, however, consisted in changes in expected future interest rates.

The first additional research hypothesis (a) was confirmed in the first chapter. In this chapter I discussed how the Polish government bond market evolved and which of its features have been stable. Its development was tightly associated with the economic transformation Poland has undergone. However, its evolution was mostly complete by 2005, despite multiple external events, large-scale changes in the ownership structure, domestic and foreign monetary policies as well as fiscal policy changes. Of greatest importance, in my view, is the fact that the maturity structure of Polish government debt has been broadly stable since 2005 and that the average size of a typical bond issue stabilized in real terms at PLN 20 bn. I also found that the market was consolidated into several large benchmarks. I concluded that the stability of the market allows for unhindered use of data from that period.

The second additional research hypothesis (b) posited that the liquidity of the local currency bond market in Poland depends on both domestic and local factors, but overall liquidity has improved over

the past decade. This hypothesis was confirmed in chapter 2, in which I investigated the liquidity of the Polish government bond market. Having explored various measures of liquidity and taken into consideration data availability, I have decided on the bid-ask spread as the preferred measure. I used a proprietary database of individual daily bond prices webscrapped from the Warsaw Stock Exchange's BondSpot platform and assessed the determinants of bond liquidity with the use of panel regressions. I showed that bond liquidity increases with the size of the bond issue, is lower for longer-duration securities and for bonds with higher coupon rates. In addition, I found that liquidity tends to decline towards year-end and on auction days. I also explored the impact of external events on bond liquidity and found that in times of financial stress and volatility, liquidity tends to deteriorate. However, policy announcements of major central banks have had no discernible impact on Polish government bond liquidity. Finally, I established that, controlling for all aforementioned factors, liquidity slightly improved over the 2006-2018 period.

The fifth chapter of my dissertation two additional research hypotheses were verified (c and d). The chapter dealt with the effects these policies had on emerging markets. In that chapter I analyzed the available empirical studies to assess the channels and the extent to which they affected EM economies and financial markets. I found that monetary easing by major central banks raised economic growth in EM countries, strengthened their currencies, lowered their bond yields, raised EM equity prices and boosted capital flows from DM to EM countries. I also concluded that the existing empirical literature is uneven and concentrated on the impact of the Federal Reserve's policies on East Asian and Latin American EMs. CEE region appeared somewhat underrepresented.

Piotr Bortkiewicz

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